Control Room Management

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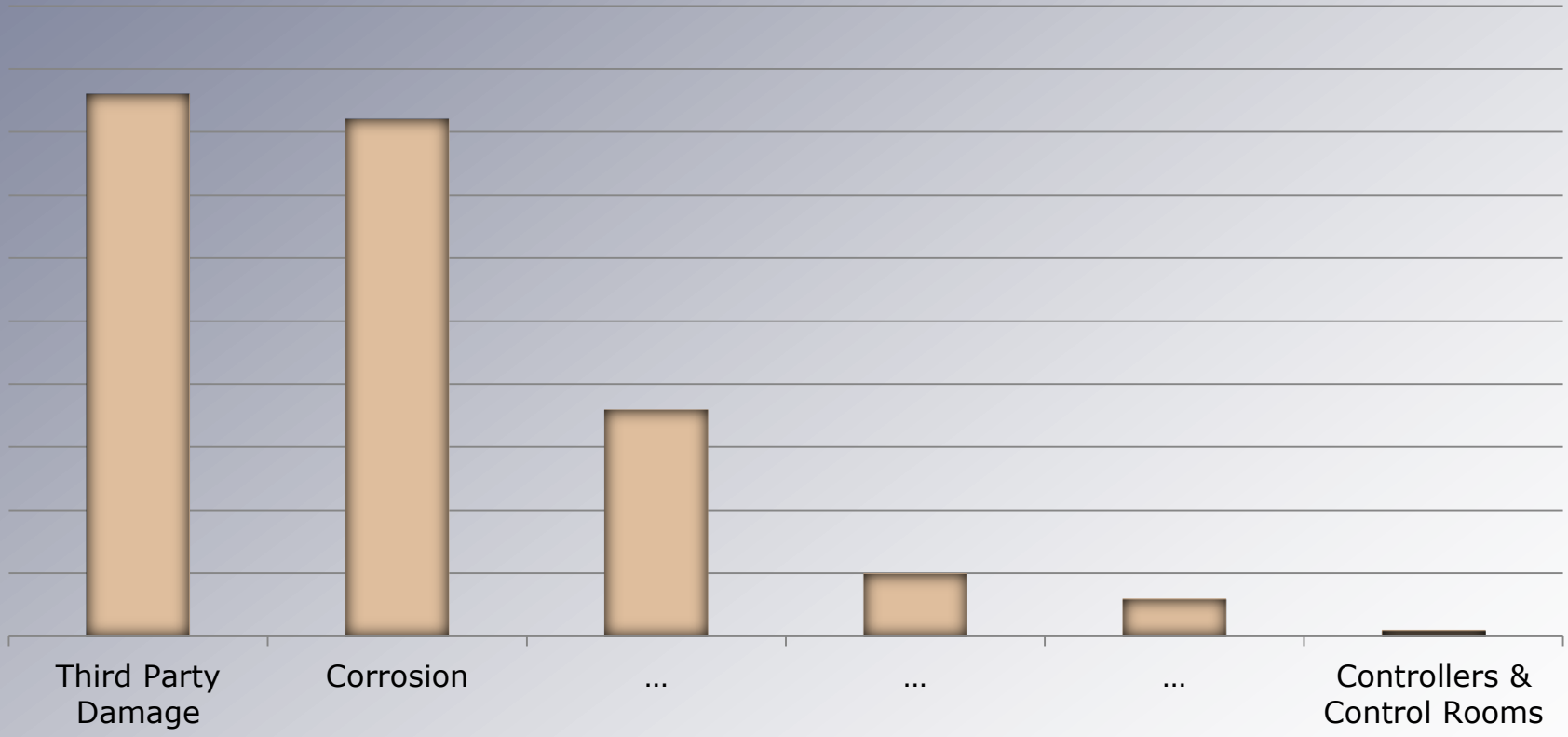
Background

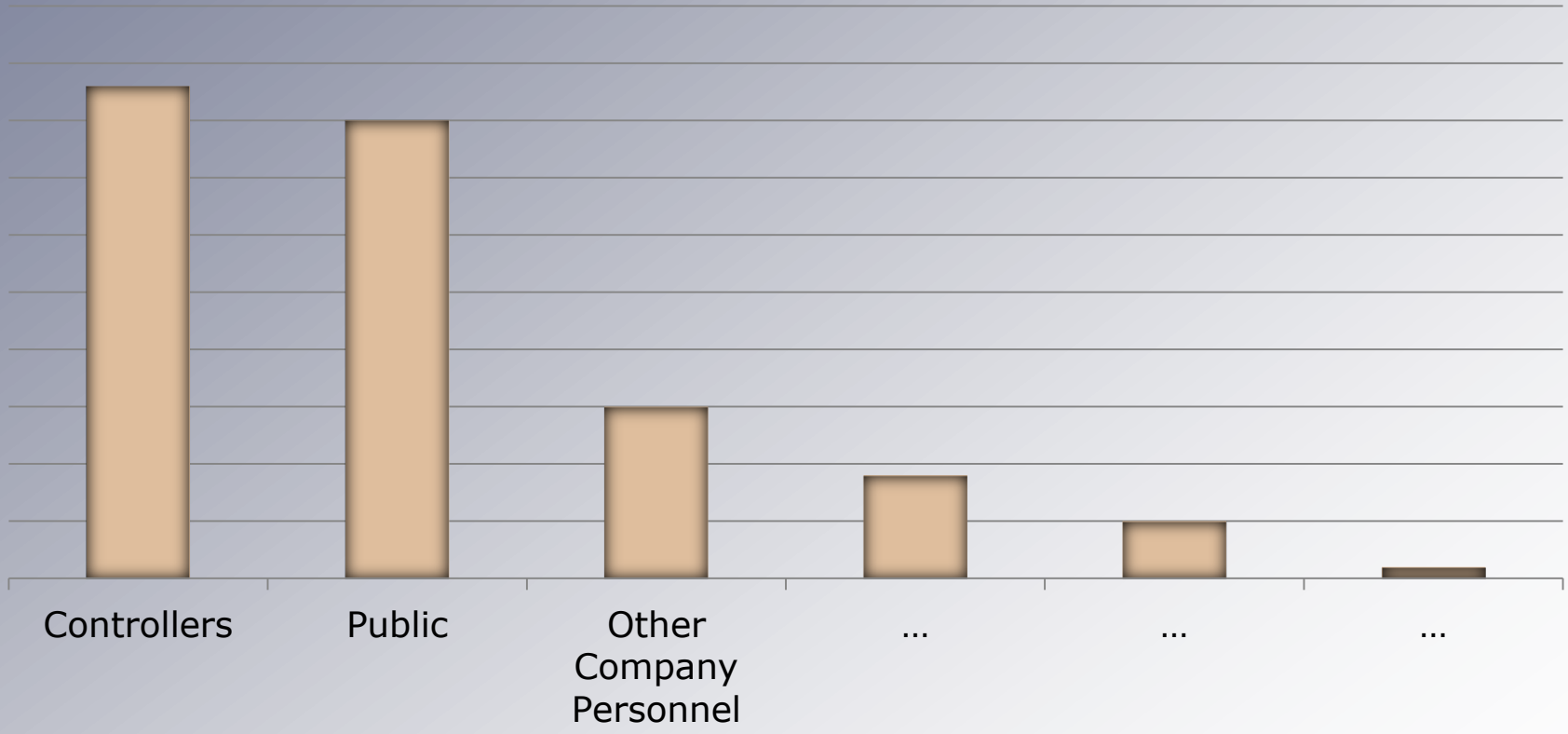
- PHMSA has been examining Control Room operations for 10+ years
  - Three Advisory Notices on SCADA & Fatigue (1999, 2003, 2005)
  - SCADA System Check List Initiated (1998)
  - T&Q SCADA Training Class Developed (2001)
- Pipeline Safety Improvement Act of 2002 (Section 13b)
  - CCERT Study of control room operations to enhance pipeline safety (2003-2006)
  - Two CRM Workshops (2006, 2007)
  - OQ Report to Congress, Section 6 (Dec-2006)
- National Transportation Safety Board
  - SCADA Safety Study (2005)
  - 10 of 18 Hazardous Liquid accidents have potential CRM involvement (1998-2005)
- PIPES Act of 2006 (Sections 12, 19, 20)
  - Establish human factors management plan
  - NTSB Recommendations on Displays, Alarms and Training
  - Accident/incident form changes on Fatigue
  - Issue Regulations

Principle Cause of Pipeline Incidents and Accidents



* Artificial Data for illustrative purposes

Who initially detects Pipeline Leaks & Failures



* Artificial Data for illustrative purposes

Risk and Consequence

- A Controller's job places them in a critical position to avert the development of abnormal situations
- Controllers know how to complete actions but they do not always:
  - Detect and react in a timely fashion
  - Choose the right action
- Low probability of controller error is frequently offset by the potentially high consequence of their involvement
- Controller responses to developing abnormal conditions, incidents and accidents can alleviate or exacerbate the consequences of some events, regardless of the initial cause

Case History Examples

- Inadequate shift change linked to tank overflow and explosion
- Controller was not able to discern an abnormal operating condition among other alarms resulting in equipment failures
- Incorrectly displayed pressure data misled the controller, resulting in a rupture
- Confusion over a relocated valve contributes to magnitude of accident
- Lack of coordination between controller and SCADA technician contributed to significant product release, fire and three fatalities

Root Cause
Controllers or Control Rooms?

- Controllers must be qualified to perform their safety-related duties.
- Controllers use their experience, training, technical skills and intuition.

However…

- They are dependent on the design, performance, robustness of applied SCADA systems and support applications.
- They are dependent on the thoroughness of procedures.
- Controllers are also dependent on the actions of others.

Case History – Second Look

- Inadequate shift change linked to tank overflow and explosion (poor or missing procedures?)
- Controller was not able to discern an abnormal operating condition among other alarms resulting in equipment failures (absence of alarm management?)
- Incorrectly displayed pressure data misled the controller, resulting in a rupture (Inadequate SCADA design?)
- Confusion over a relocated valve contributes to magnitude of accident (Change Management?)
- Lack of coordination between controller and SCADA technician contributed to significant product release, fire and three fatalities (Communications?)

Objective

- **Help assure controllers will continue to be successful in maintaining pipeline safety and integrity**
  - Verify that procedures, systems and equipment are well thought out, and function as designed
  - Assure pipeline operators are addressing fatigue risks in the control room

Focusing our Attention on Risk

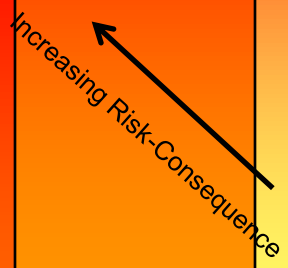
- Remote monitor/control may be performed in a formal control room, or numerous less formal settings such as individual office, service vehicle or residence
- Location of control actions does not define the nature or complexity of operations
- Established definitions for large or small operators, and less than 20% smys, are not good qualifiers in defining control room risks
- More complex and diverse operations call for more thorough control room systems and processes
- Involvement of field personnel in control activities has the potential to influence risk
- Most operators are performing a subset of good control room practices, but frequently without a basis for their design choices, and sometimes without formalized procedures

Pipeline CRM Risk Matrix

--- Risk derived from monitor and control ---

Red indicates highest risk, Yellow indicates lower risk

Pipeline Control Risk Matrix		Hazardous Liquids	Gas Transmission	Gas Distribution
Remote Operation	Remote monitor & remote control			
	Remote monitor; action by others			
Individual Field Station Operation	Local facility with centralized control panel			
	Individual equip. with status control and indicators			



Matrix coding principally represents the combination of frequency and consequence of pipeline upset conditions and failures, where CRM may be a contributing factor

Safety Pyramid

Serious Failure

Significant and
Minor Events

Intervention by
Controllers, other
Personnel and
Safety Systems

Near Miss, Identified

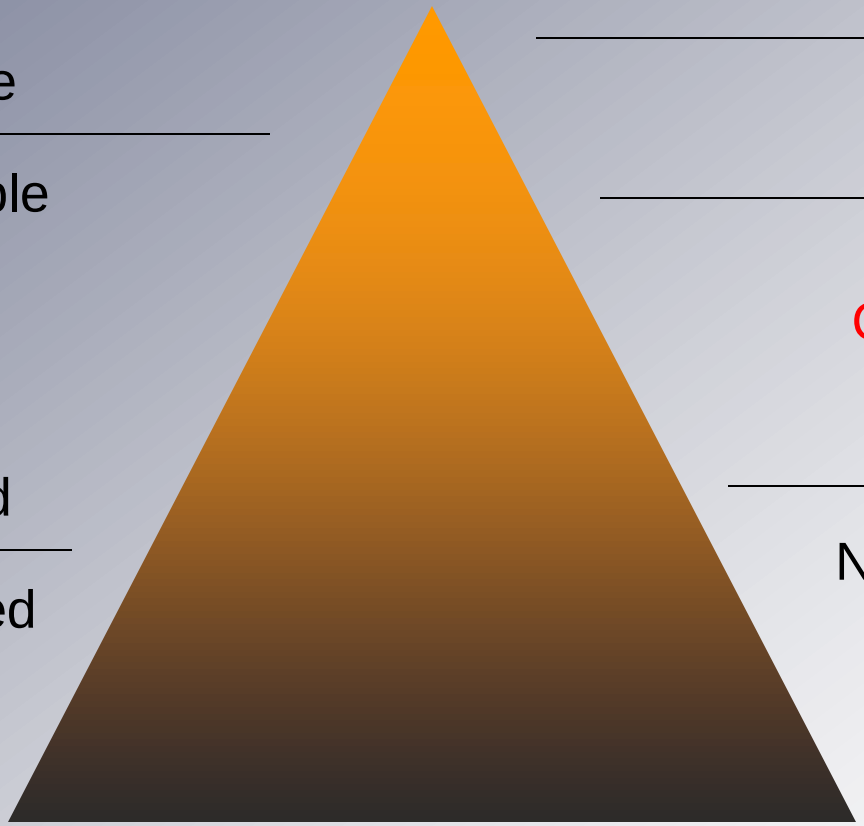
Near Miss, Undetected

Reportable

Un-reportable

Recorded

Un-recorded



Control Room Management Processes can help assure that developing situations don't climb the pyramid to become Significant Events or Serious Failures

Enhancement Areas - 2006

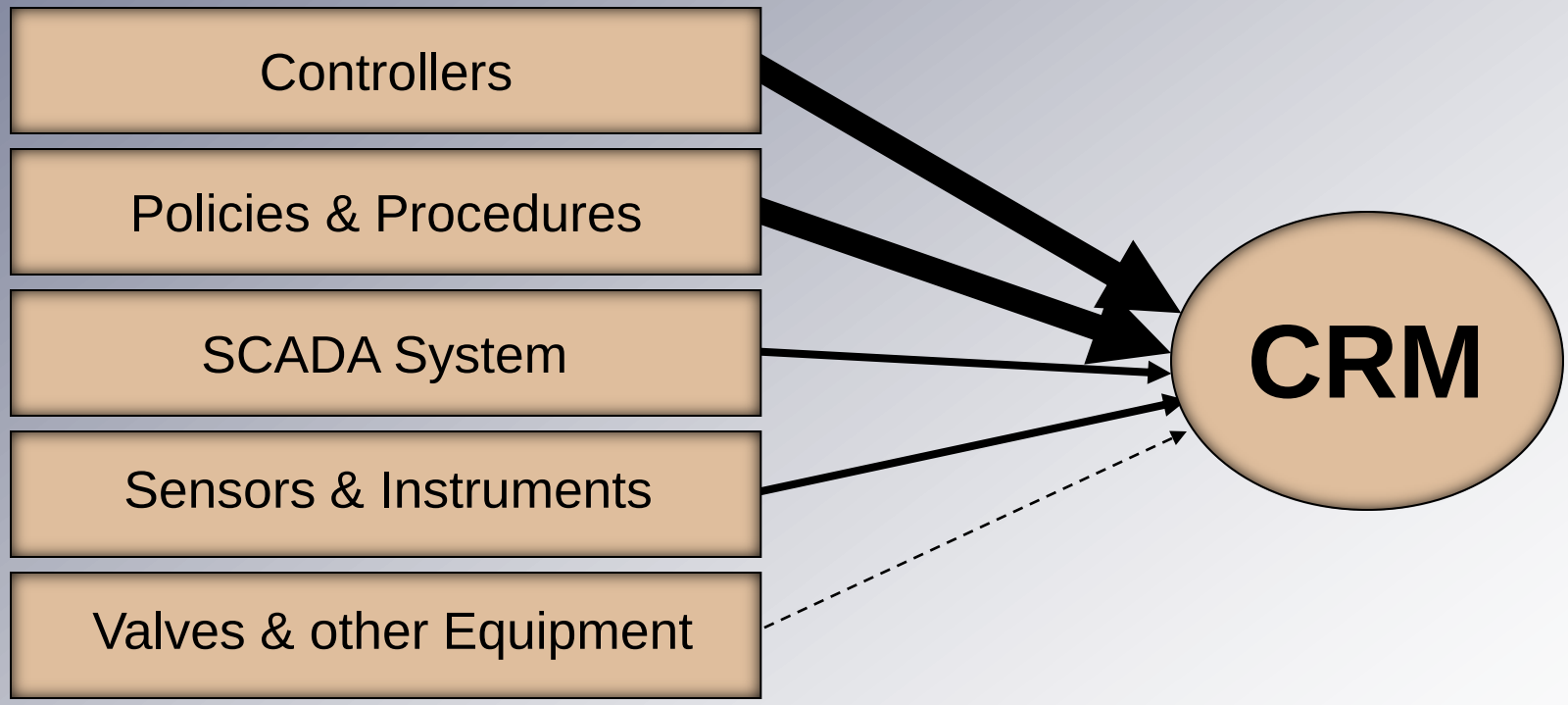
- Roles and Responsibilities
- Shift Change
- Fatigue Awareness and Mitigation
- SCADA Displays
- Point Data
- Alarm Management
- Change Management
- Qualifications
- Operating Experience and Training

Cross References

NPRM - 2008	Basis of Inclusion			Affiliations and Regulations	
Enhancement Areas	PSIA CCERT Study Outcomes	Pipes Act	NTSB Recommendations	PHMSA Advisory Bulletins & Reg.Codes	Industry RP's and Standards
Roles & Responsibilities	X				API RP-1168** API RP-1162
Shift Change	X				API RP-1168**
Fatigue Awareness & Mitigation	X	Section 12	P-98-30^, P-99-12^	ADB-05-06	API RP-1168**
SCADA Displays	X	Section 19	P-05-01^,P-98-22^, P-93-22^	ADB-99-03	API RP-1165
Point Data	X				
Alarm Management	X	Section 19	P-05-02^, P-98-22^		API RP-1167** AGA White Paper*
Change Management	X			ADB-99-03 ADB-03-09	API RP-1168**
Qualifications	X			195.500, 192.800 193.2700	API RP-1118, 1161 ASME B31Q
Operating Experience & Training	X	Section 19	P-05-03^, P-98-21^	195.500, 192.800 193.2700	
Executive Validation	X	Section 16		ADB-07-01	

(*)Under Development (**)New since NPRM (^)Closed Recommendation

Control Room Management
People - Process - Pipeline



49CFR : 192.631 & 195.446

- a) General *
- b) Roles and Responsibilities
- c) Adequate Information *
- d) Fatigue Mitigation
- e) Alarm Management
- f) Change Management *
- g) Operating Experience
- h) Training
- i) Compliance Validation
- j) Compliance Deviation

* - Subtle Differences between 192 & 195

Revised Final Rule

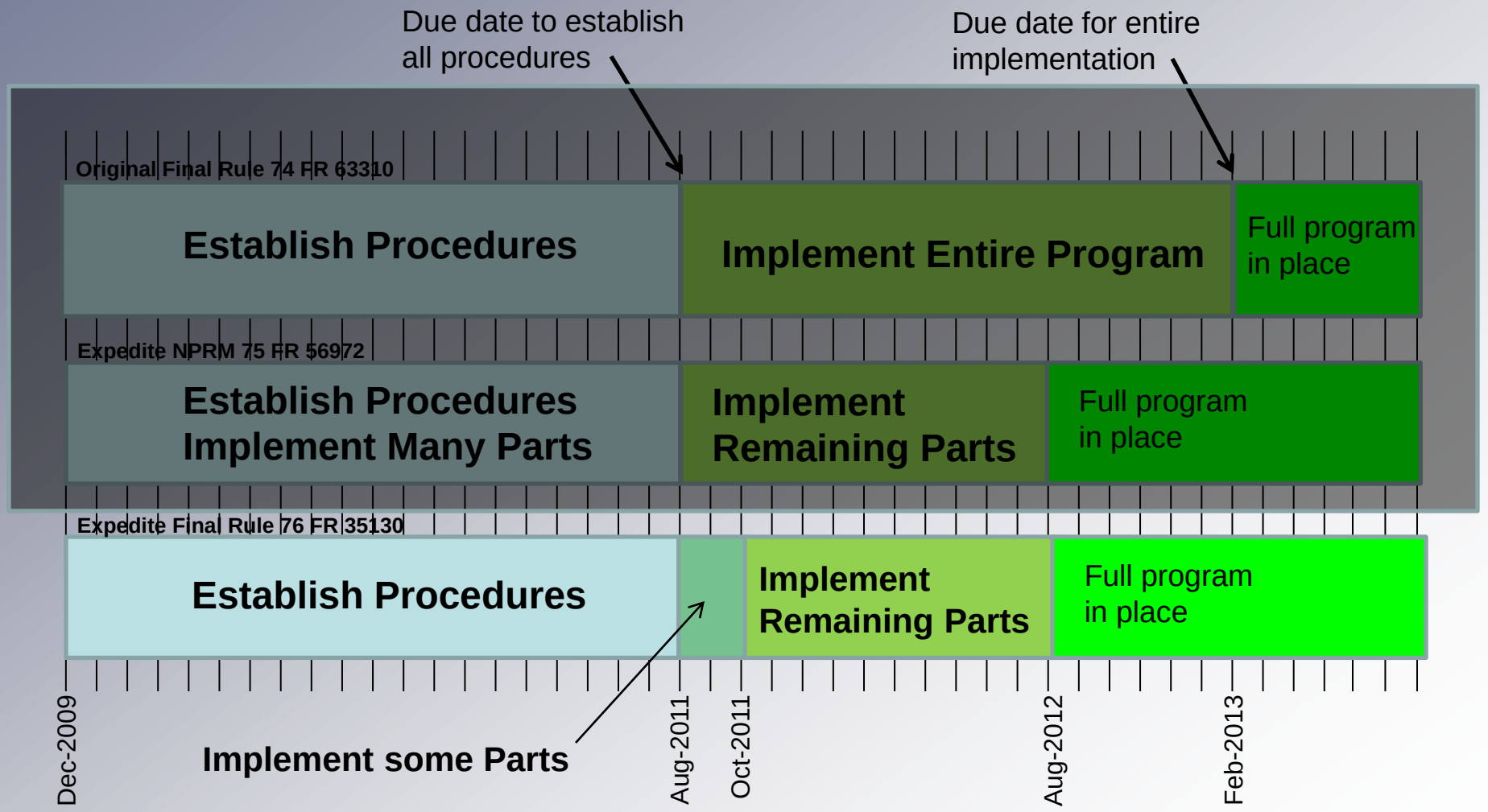
- Revised Final Rule published June 16, 2011
- The plans and procedures must be established August 1, 2011
- Certain program elements need to be implemented by October 1, 2011
- Implementation of remaining program elements are due August 1, 2012

Revised Final Rule

TABLE 1—PROGRAM IMPLEMENTATION DEADLINE FOR DIFFERENT PARAGRAPHS

Paragraph	(b) Roles & responsibilities	(c) Adequate information	(d) Fatigue mitigation	(e) Alarm management	(f) Change management	(g) Operating experience	(h) Training
~~Current Regulations.~~	~~Feb 1, 2013 .....~~	~~Feb 1, 2013 .....~~	~~Feb 1, 2013 .....~~	~~Feb 1, 2013 .....~~	~~Feb 1, 2013 .....~~	~~Feb 1, 2013 .....~~	~~Feb 1, 2013.~~
~~NPRM .....~~	~~Aug 1, 2011 .....~~	~~C5 Aug 1, 2011 ... C1–4 Aug 1, 2012~~	~~Aug 1, 2011 .....~~	~~Aug 1, 2012 .....~~	~~Aug 1, 2011 .....~~	~~Aug 1, 2011 .....~~	~~Aug 1, 2011.~~
Final Rule	Oct 1, 2011	C5 Oct 1, 2011 .... C1–4 Aug 1, 2012	D2 & D3 Oct 1, 2011. D1 & D4 Aug 1, 2012.	Aug 1, 2012	Oct 1, 2011	Oct 1, 2011	Training elements aligned to due date of each element.

New Final Rule : Impact on Timeline



Control Room Inspections

- Performed by inspectors from both PHMSA or our state partners, based on established federal or state jurisdiction
- Inspections began in Oct-2011, heavier in 2012
- Inspections based on Control Rooms
- Inspection checklists and guidance made public in June-2011
- After initial regulatory compliance is established, control room requirements will become a part of general regulatory review during traditional and specialized inspections in the future.
- Control Room actions will become a more important part of incident and accident investigations

Implementation Timelines

- Implementation of "procedural" elements were due on October 1, 2011, examples:
  - Shift Change Process
  - Change Management
  - Fatigue Awareness/Mitigation Training
  - Operating Experience
- Implementation of remaining program elements were due August 1, 2012, examples:
  - Hours of Service
  - Alarm Management
  - Data Point Validation
  - Display Standards
- Training in place as each of these elements are deployed

Special Notes

- New regulations do not change any existing jurisdictional boundaries
- New regulations do not require operators to have SCADA systems, control rooms or controllers.
- An operator can have a SCADA system without controllers, thereby no CRM implementation
- Type A Gathering is treated in some ways like transmission line and could require CRM regulations
- Some small LDC's with control rooms are only required to have (essentially) fatigue mgt
  - Less than 250,000 customers, and
  - Transmission lines without compression

http://primis.phmsa.dot.gov/crm/

- Reference Materials
- Background Documents and PPTs
- Frequently Asked Questions
- Inspection Guidance

Pilot Program for Inspection Guidance Development

Operator	Type	2011 Week of
Colonial Pipeline	Large Haz Liquid	Feb 28
Kern River Gas Transmission	Med Gas Trans	Mar 14
Enterprise Products	Large Liq/Gas	Apr 04
The Energy Cooperative	Small LDC	Apr 04
Portland Montreal Pipeline	Med Haz Liquid	Cancelled, Federal Budget Issues
City of Mesa	Med LDC	Apr 18
Southern Natural Gas	Large Gas Trans	Apr 25
Ameren Corporation	Large LDC/Trans	May 23

Inspection Process

- Each inspection is based on a Control Room, not operator or inspection unit
- Paper-based inspections in 4Q-2011, 12
- Electronic files in 2012, 13
- After full program inspection roll-out, subsequent CRM inspections will be more concise

Initial Inspections – 4Q11

- PHMSA conducted 10-15 CRM inspections in 4Q11
- At least two in each region
- 100+ State and Federal Inspectors trained in Aug-Oct, 2011
- 4 – 4.5 days for these early inspections
- Region partnering and interaction with States for consistency
- States are conducting their own independent inspections
- No stated target for 2012 inspections at this time

Frequently Asked Questions

February initial release, with several updates

Applicability	23	
Adequate Information	19	69
Alarm Management	17	
Fatigue Management	12	
Roles & Responsibility	5	
All Others	16	

FAQ A.08

- If a controller directs a technician in the field to manipulate a valve, or take other action that does not involve use of, or access to, the SCADA system, is the technician in the field considered to be a controller?

  No, in this scenario the technician is not a controller.

FAQ A.10

- If a person monitors a pipeline status indication for non-operational purposes, and does not have assigned responsibility to initiate corrective action, is this person a controller?

  No. Persons that monitor a pipeline status indication for non-operational purposes, such as business or maintenance personnel, would not normally be considered controllers.

FAQ A.16

- What are "safety-related" operations and parameters in the CRM rule?

  For purposes of Control Room Management, PHMSA considers safety-related to mean any operational factor that is :

  - Necessary to maintain pipeline integrity
  - Could lead to the recognition of a condition that could impact the integrity of the pipeline
  - Could lead to the recognition of a developing abnormal or emergency situation

FAQ A.20

- Does the CRM rule apply to a local control room and station personnel that monitor and control a local operation that is completely within the fenced boundary of the local facility?

  Field personnel who exclusively operate station equipment within the defined station boundaries (fence lines or property/map boundaries) and who are not responsible for connected pipelines beyond the boundaries are not considered to be remotely monitoring and controlling a pipeline. Therefore, such personnel are not considered to be controllers.

  However, field personnel who operate station equipment within the station boundaries and also have either full-time or part-time control room operational responsibility for connected regulated pipelines beyond the station boundaries are considered controllers.

FAQ B.02

- Do I need shift hand-over procedures if I do not have 24 hour shift coverage?

  Yes. Anytime a controller completes his/her shift and/or control of the pipeline is transferred from one person to another person, shift hand-over requirements apply, even if there is a portion of time when the control room is planned to be unattended.

FAQ C.10

- If no unusual events occurred during an entire shift, would a shift hand-over procedure still have to be performed?

  Yes. The CRM regulations require the operator to define the information that will be transferred during shift turnover and the process by which this information is exchanged.

  The fact that no unusual events occurred is in itself information that an incoming controller is expected to know.

FAQ C.02

- What constitutes an adequate point-to-point verification?

  Principally, the process should verify:

  - The actual physical location and sequence among other devices and equipment at the location
  - The data, information and any control or alarm functions to/from the point are being accurately represented on all SCADA displays on which it resides

FAQ D.02

- What on-duty time must be included in the tabulation of duty hours for fatigue mitigation consideration?

  Hours of service include time while an individual is performing controller activities, including shift-change and overlap, on-call duties, events, emergency or spill drills, meetings, training, receiving or providing performance reviews and all other time the individual performs activities for the operator.

  Any and all non-controller type duties a controller performs for the operator are considered on-duty time for fatigue mitigation purposes.

FAQ D.03

- What minimum time should be scheduled between shifts to provide controllers off-duty time sufficient to achieve eight hours of continuous sleep?

  Controllers must have an opportunity for eight hours of continuous sleep between shifts.

  PHMSA encourages at least ten continuous hours of off-duty time to allow for commutes and other personal activities prior to going to sleep or after waking up. Shorter/longer commute times or the availability of nearby sleep facilities may influence the appropriate amount of off-duty time.

FAQ E.06

- Does the requirement to annually monitor alarm activity require an operator to conduct a formal work / time-study?

  Operators must monitor the overall content and volume of activity for a controller. The process by which this monitoring is to be done is not specified, but is expected to have a sufficient degree of formality and documentation. Operators must monitor the content and volume of activity being directed to a controller to substantiate any conclusions about maintaining or changing assigned duties.

FAQ F.02

- If piping changes are being considered at a field location that do not impact any SCADA data, must the control room still be involved in change management discussions?

  Yes. Even though SCADA data may not be impacted, the hydraulics performance of the pipeline system could be affected in a way that impacts control room operations.

  SCADA data is not the only thing that could impact control room operations. For example, replacing a mainline valve may not change any SCADA data, but such a change may impact valve cycle time which can be a very critical factor for controllers. The operator must define, in its CRM program, what impending field changes will be included in the management of change process.

Inspection Guidance and Questions

B1-1:	**Has the operator adequately defined a controller's authority and responsibility to make decisions and take actions during normal operations?**	**Procedure** **[ ] SAT** **[ ] UNSAT** **[ ] NA**	**Implementation** **[ ] SAT** **[ ] UNSAT** **[ ] NA**	**Notes/Comments**
B1-1c:	If the physical domain of responsibility periodically changes, has a clear procedure been established to describe the conditions for when such a change occurs? • Some operators consolidate control room operations on night shifts, after normal business hours, or on weekends by reducing staff. • Moving operations to another location must include a formal transfer of responsibilities, including shift-change forms or other documentation. • If the domain of responsibility is transferred to a different location, procedures should define how the actual time of transfer is made clear to both controllers. • Consolidating control room operations by reducing staff or transferring to another location for operational needs does not necessarily have to occur at normal shift change times, but will require the formality of shift change. Special or unusual operations sometimes prompt operators to bring help into the control room. On such occasions, clarity about who is responsible for what is very important.	[ ] Y [ ] N [ ] NA	[ ] Y [ ] N [ ] Observed [ ] Records [ ] Interview	

Inspection "Tips"

- Dependency on Color Acuity
- Consistent Use of Colors
- Shift Change Content & Records
- Schedule Upsets & the Domino Effect
- Controller Commute Times

Inspection "Tips"

- Logging Controller Hours
- Controllers working "after hours"
- 7 day sliding window
- Tracking Hours of 'back-up' Controllers

Inspection "Tips"

- Control Actions : autonomy or mgt involvement
- Evacuating the Control Room
- SCADA Outages
- Definitive and Consistent Safety-Related Data Points
- Alarm Descriptor Clarity and Consistency
- Excessive or Cyclical Deviations
- Evolution of Procedures

Control Room Management

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or
http://primis.phmsa.dot.gov/crm/index.htm
(Feedback) – to ask questions of PHMSA's CRM Team